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(54) IMPROVEMENTS RELATING TO ELECTRIC IMMERSION HEATER AND THERMAL CONTROL UNITS THEREFOR

(71) We, JOHN CRAWSHAW TAYLOR, a British subject, and OTTER CONTROLS LIMITED, a British Company, both of Otters 'Ole, Market Street, Buxton, Derbyshire, do

hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a thermal control unit for an electric immersion heater.

More particularly the invention relates to a thermal control unit of the kind which is in use secured to the head of an electric heating element of an immersion heater, which head is itself in use mounted in or adjacent an aperture in the wall of a vessel fitted with such a heater, the control unit having terminals for electrical connection to the cold leads of the heating element and incorporating a thermally sensitive electric switch including a bimetallic snap-acting switch-actuating member positioned at an end of the control unit so as in use of the control unit to be in direct thermal contact with said head. Such a thermal control unit is that hereinafter referred to as being "of the kind described".

Specification No. 1 430 229 discloses a thermal control unit of the type decribed having a moulded plastics body with an earth, a live and a neutral terminal pin extending outwardly from one end of the body. The neutral and live pins are hollow, formed from sheet metal, are of circular cross-section, and are each internally reinforced by a moulded plastics pin on a cover plate which, in the assembled unit, overlies and protects the contacts of the electric switch.

The present invention provides a thermal control unit of the kind described, the unit having a moulded plastics body, an earth terminal pin and two mains terminal pins extending from one end of said body for engagement with an electrical supply socket, each of said terminal pins being of hollow construction formed from sheet material integrally with a conductive strip and being supported internally by a moulded plastics reinforcing pin extending from a moulded plastics clamping member which also serves to clamp the terminal pins in place within said body.

The present invention thus extends the economic benefits of reinforced hollow terminal pins to the earth pin of the control unit, and provides that all three terminal pins are clamped in place in a single operation thus obviating the need to otherwise locate any of the pins and simplifying the manufacturing process. It is preferred that the moulded plastics body be of substantially circular-cylindrical cup-like form, closed at the said one end from which the terminal pins extend, the said bimetallic switch-actuating member being positioned at the open end of the body, and switch contacts of the said electric switch being mounted within the body.

Preferably, the switch contacts are clamped in place within the body by the clamping member.

Preferably, the clamping member is held in place by moulded plastics pins integral with the body of the control unit, said pins extending through apertures in the clamping member and having their ends burred or welded over.

To facilitate assembly the control unit is preferably so arranged that all the terminal pins and the switch contacts of the electric switch are inserted into the moulded plastics body in the same direction as the clamping member.

While the terminal pins may be formed into any desired cross-sectional shape, it is preferred that they have a rectangular outline in cross-section.

The terminal pins are preferably passed through closely fitting apertures in the said one end of the body.

At least one of the reinforcing pins is preferably provided with a thickened portion which is arranged to abut with the root end of the hollow pin which it reinforces so as to provide the terminal pin with additional axial support.

A shroud member is preferably provided, surrounding the terminal pins, to protect the terminal pins and/or serve as a guide for a mains supply socket.

One or more of the pins may be provided with an enlarged head at the root thereof, the enlarged head engaging the said one end of the moulded plastics body. This form of construction is described in more detail in co-pending application No. 35360/76 (Serial No. 1 592 848).

An embodiment of the invention will now be described by way of example and with reference to the accompanying drawings, in which:—

Fig. 1 is a perspective view of a control unit in accordance with the invention together with a part of an immersion heater and a shroud member;

Fig. 2 is an end elevational view of the open end of the control unit of Fig. 1 with its clamping plate removed;

Fig. 3 is a perspective view of the clamping plate and the terminal pins of the control unit of Fig. 1;

Fig. 4 is a cross-sectional side view of the control unit of Fig. 1;

Fig. 5 shows a bimetallic snap-acting switch actuating member;

Fig. 6 shows a metal blank for forming the neutral terminal pin of the control unit of Fig. 1;

Fig. 7, 8 and 9 are front, side and end views respectively of the neutral terminal pin of the control unit of Fig. 1; and

Fig. 10 is a view of portions of a metal blank for forming the earth terminal pin of the control unit.

Fig. 1 shows a thermal control unit 1 according to the invention, arranged for assembly with an electric immersion heater comprising a copper sheathed element 2 and a brass head 3 to which the control unit is to be secured. When the parts illustrated are assembled, cold leads 4 of the element 2 extend through the control unit 1 for connection to connector tabs 5 and 6 in apertures in a base part 7 of the control unit, while earth lead 8 passes through the control unit to emerge in a cylindrical aperture 9 of the base part 7. The free end of earth lead 8 is threaded and when the parts are assembled carries a nut which serves to secure the control unit 1 to the head 3. A hollow earth terminal pin 10 and hollow live and neutral mains terminal pins 11 and 12 project from the base part 7, and are protected by shroud member 13 which also serves as a guide for a mains supply socket connector (not shown).

Thermal control unit 1 has a circular-cylindrical cup-like moulded plastics body 14, closed at one end by the integral base part 7. Hollow pins 10, 11 and 12 are of rectangular cross-section, are of formed-up construction, which will later be described, and are provided with integral conductive strips which extend in planes substantially normal to the pins' axes. The arrangement of the integral conductive strips within the body 14 of the control unit is shown in Fig. 2, which also shows a conductive strip 15 carrying a movable contact of a thermally-sensitive switch. Conductive strip 15 is formed integrally with connector tab 5, and its contact makes and breaks connection with a fixed contact 16 which is connected by an integral conductive strip 17 with the live pin, so that connection may be broken between the heater element and the live pin. Connection between the neutral pin 12 and the immersion heater cold lead connected to connector tab 6, is directed via conductive strip 18 which is formed integrally with both connector tab 6 and neutral pin 12. Earth pin 10 is formed integrally with conductive strip 19 and a terminal 20 which has a circular hole whose centre coincides with the axis of aperture 9 in the base part 7 (Fig. 4), but whose diameter is smaller. The nut carried by earth lead 8, and which serves to secure control unit 1 to head 3, is thus tightened against terminal 20 so that connection is established between earth pin 10 and earth lead 8. An earth tube 39 connects the brass head 3 and the earth terminal 20. Conductive strips 15, 17, 18 and 19 are all carried on upstanding portions of the base part 7 and are located by upstanding pins 21', 21" moulded integrally with the upstanding portions.

Upstanding pins 21", which locate the conductive strips 15, 17, 18 and 19, along with the other upstanding pins 22, pass through apertures in, and serve to locate a clamping plate 23 (Figs. 3 and 4) which is secured in place in the open end of the control unit body 14 by burring or welding over the projecting ends of the upstanding pins. Clamping plate 23 is provided with upstanding portions and serves to clamp the conductive strips 15, 17, 18 and 19, and hence terminal pins 10, 11 and 12, to the base 7 of the body 14. Clamping plate 23 is also moulded integrally with reinforcing pins 24 which, when the clamping plate is in place, extend down into the hollow terminal pins to provide them with both extra stiffness against buckling and more positive directional location at their roots. While the reinforcing pins illustrated extend substantially the full length of the hollow terminal pins' interiors, it is not necessary that they be this long in order to provide substantial support to the terminal pins.

In addition to being located by the clamping plate and reinforcing pins in the manner described above, the pins are located by being received in closely fitting apertures in the base part 7. This serves not only to locate the pins more positively but also to maintain the shape of the pins at their roots, this latter function being particularly important when rectangular-section pins of the type illustrated are employed, since these pins comprise a pair of channel sections which, whilst

joined at the pin's tip, are otherwise free to move relative to one another at the root of the pin. Additional axial support is afforded earth pin 10 by the abutment of the root end of the pin with a thickened portion 25 of its reinforcing pin 24, which extends around three of the four sides of the rectangular cross-section of the reinforcing pin; the other side of the reinforcing pin is left planar to permit the integral conductive strip 19 to lie flat against it. A similar thickened portion is provided on the reinforcing pin for live pin 11, and a similar provision could of course be made to support neutral pin 12 if desired.

Located on the other side of clamping plate 23 to that bearing reinforcing pins 24, is a dished bimetallic member 26 (Fig. 5) which acts as a snap-acting thermally-responsive actuating member for the electric switch comprised by movable and fixed contacts 15 and 16. Bimetallic member 26 is as disclosed and claimed in Patent Nos. 1,542,252 and 1 546 578 and comprises a member of sheet bimetal having an aperture with an arcuate outer perimeter and an inner perimeter defining a tongue 27 free at one end, said free end being close to said outer perimeter, said outer and inner perimeters smoothly merging at rounded ends of the aperture adjacent the tongue root, an area of the member surrounding the tongue 27 and in relation to which the tongue 27, at least in part, is generally centrally disposed, having been deformed in a die pressing operation to conform in shape to a die of domed configuration, the domed area being such as to reverse its curvature with a snap action with change in temperature, and the width of the domed area surrounding the tongue measured generally, radially from the centre of the domed area being greatest in the region of the tongue root. This in effect means that peripheral portion 27 moves between two positions at different spacing from fixed contact 16, to move the conductive strip 15 via connecting rod 29 (Fig. 4). A brass pin 30 extends through a hole 31 in the tongue 27 and into the clamping member 23, so as to secure the former in place. An upstanding pin 32 on clamping member 23 passes through a hole 33 in the tongue 27, and serves to prevent relative rotation of the two members about pin 30. A further upstanding pin 34 abuts with bimetallic member 26 and serves to bias it towards the dished position shown. Bimetallic member 26 is in thermal communication with the immersion heater element 2 via protrusion 35 on the head 3, and operates to open the electric switch to cut off power to the heater element upon its overheating.

Both the body 14 and the clamping plate 23 are moulded from thermoplastics since this material permits more intricate mouldings than thermosetting plastics which are often employed in plug units, and thus the reinforcing pins 24 and the upstanding locating pins may be accurately and reliably moulded.

It will be noted that all the components contained within control unit body 14, namely the terminal pins 10, 11 and 12, conductive strip 15, clamping plate 23 and connecting rod 29, may be set in place from the same direction, and this feature permits a simpler manufacturing process than if the earth pin is moulded in with the base part 7 or set in place from the opposite direction to the mains terminal pins, such as is sometimes the case when the earth pin is not constructed in accordance with the invention.

Fig. 6 shows a metal blank for forming the neutral terminal pin 12 as shown in Figs. 7, 8 and 9. Fig. 10 shows the shape of the central portion of the blank for forming the earth pin 10 which employs a different form of taper at its tip. All three hollow terminal pins are constructed in accordance with the invention of co-pending patent application No. 35360/76 Serial No. 1 592 848 relating to such pins, and each pin comprises two channel sections 36 and 37 in side by side relation with their free edges touching. The channel sections are joined at the pin's tip by a connecting strip 38 and are so shaped as to produce taper at the pin's tip in respect of both its thickness and its width.

WHAT WE CLAIM IS:—

1. A thermal control unit of the kind described, the unit having a moulded plastics body, an earth terminal pin and two mains terminal pins extending from one end of said body for engagement with an electrical supply socket, each of said terminal pins being of hollow construction formed from sheet material integrally with a conductive strip and being supported internally by a moulded plastics reinforcing pin extending from a moulded plastics clamping member which also serves to clamp the terminal pins in place within said body.

2. A unit as claimed in claim 1, wherein the moulded plastics body is of substantially circular-cylindrical cup-like form, closed at the said one end from which the pins extend.

3. A unit as claimed in claim 2, wherein the bimetallic switch-actuating member is arranged at the open end of said body, and switch contacts of said electric switch are mounted within said body.

4. A unit as claimed in claim 3, wherein the switch contacts are clamped in place within the body by the clamping member.

5. A unit as claimed in any preceding claim, wherein the clamping member is received in said moulded plastics body by means of plastics pins provided on said body extending through apertures in the clamping member and having their ends burred or welded over.

6. A unit as claimed in any preceding claim, wherein all the terminal pins and the switch contacts of the electric switch are inserted in the moulded plastics body in the same direction as the clamping member during assembly.

7. A unit as claimed in any preceding claim, wherein all the terminal pins are rectangular in cross-section.

8. A unit as claimed in any preceding claim, wherein the pins pass through closely fitting apertures in the said one end of the body.

9. A unit as claimed in any preceding claim, wherein at least one of the plastics reinforcing pins comprises a thickened portion which abuts the root end of the hollow pin which it reinforces.

10. A unit as claimed in any preceding claim, further comprising a shroud member surrounding the terminal pins.

11. A unit as claimed in any preceding claim, wherein at least one of the terminal pins is provided with an enlarged head at the root thereof, which enlarged head engages said one end of said body.

12. A unit as claimed in any preceding claim, wherein the bimetallic element comprises a member of sheet bimetal having an aperture with an arcuate outer perimeter and an inner perimeter defining a tongue free at one end, said free end being close to said outer perimeter, said outer and inner perimeters smoothly merging at rounded ends of the aperture adjacent the tongue root, an area of said member surrounding said tongue and in relation to which said tongue, at least in part, is generally centrally disposed having been deformed in a die pressing operation to conform in shape to a die of domed configuration, said domed area being such as to reverse its curvature with a snap action with change in temperature, and the width of the domed area surrounding the tongue measured generally radially from the centre of said domed area being greatest in the region of the tongue root.

13. A thermal control unit substantially as herein described with reference to the accompanying drawings.

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1594094 COMPLETE SPECIFICATION
2 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 1

FIG.1.

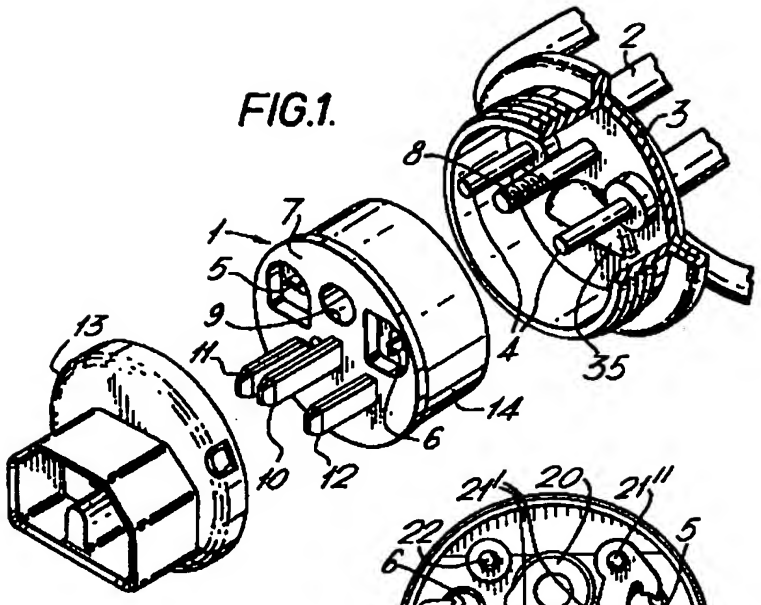
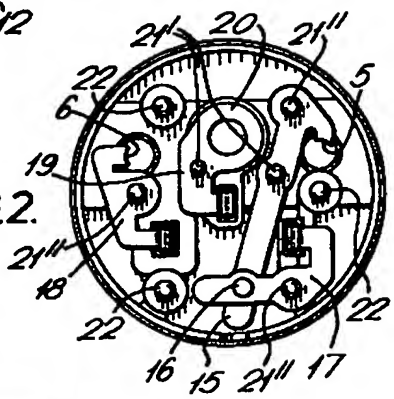


FIG.2.



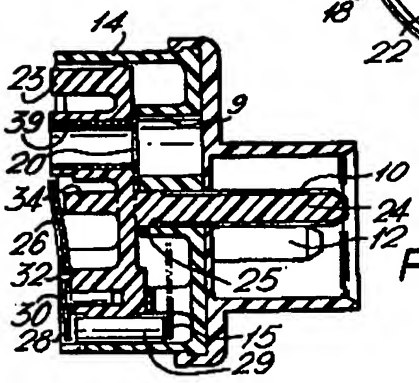


FIG.4.

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Sheet 2

FIG.3.

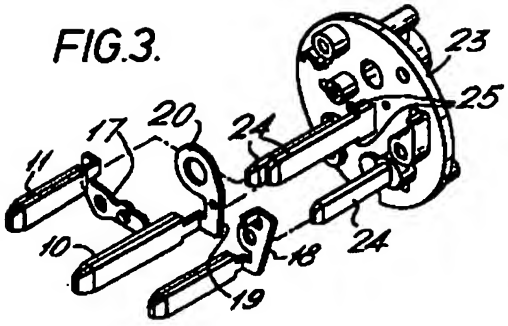
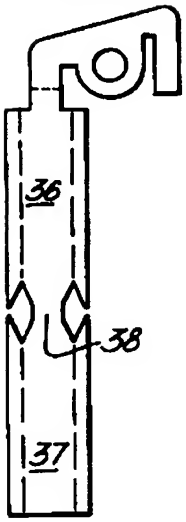


FIG.6.



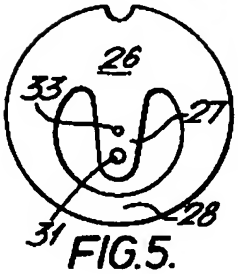


FIG.5.

FIG.7.

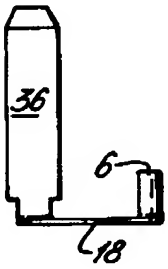


FIG.10.

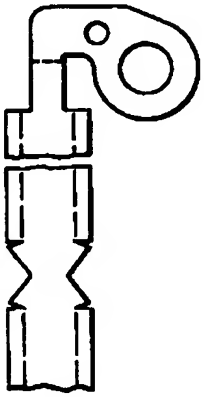


FIG.8.

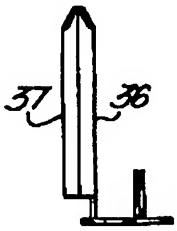


FIG.9.